

**Klamath Network Climate Change Scoping Meeting**  
**May 6-7, 2008**  
**Ashland, Oregon**

**Meeting Notes**

***Purpose of the Workshop***

In 2005 the Klamath Network staff, Chiefs of Interpretation for the 6 parks, and staff from Southern Oregon University got together to develop the Klamath Network's Strategic Interpretive Plan. The purpose of the interpretive plan is to build a framework for the creation of thoughtful and meaningful interpretive products to the parks, residents, and visitors of the Klamath Region. The plan was structured to guide the development of I&M topic-based interpretive themes, broad enough to fit all network parks. The five topics selected as part of this plan were Biodiversity, Non-native Species, Climate Change, Water Quality, and Wetland Inventory. Climate change will be the focus for the 2008-2009 project. The purpose of the climate change workshop was to bring together the interpretive and natural resource staff of the 6 parks that make up the Network to discuss climate change. The purpose of this discussion was to gain an understanding of our current knowledge about climate change, determine what data is available to help the interpretive staff discuss climate change with the public, and to try and figure out what interpretive products we could develop to help park staff discuss climate change with the public.

***Objectives of the Workshop***

1. To develop a broad understanding of climate change as it affects national parks of the Western U.S.
2. To develop park specific understanding about the effects of climate change on parks within the Klamath Network.
  - a. *Identify and prioritize Focal Elements that will be affected by climate change in each park*
  - b. *Identify and prioritize key topics of the visitor experience that are likely to be affected by climate change*
3. To develop interpretive topics and projects that can be used to convey climate related information to the public.
4. To determine possibilities for future research and partnerships that can be used to help us communicate climate change issues to the public.

***May 6<sup>th</sup> (Tuesday)***

***Introduction***

Sean Mohren led the workshop by providing an overview of what the Network hoped to accomplish during the 2 day event. He mentioned there was a good mix of natural resource staff, interpretive staff, Resource and Interpretive Chiefs, and Superintendents. He reviewed the goals and objectives of the meeting but made it clear this was a scoping / brainstorming meeting so the agenda would be flexible depending on how the discussions over the next 2 days developed. He also discussed the following:

- Network Updates: (1) REDW Intertidal Protocol was approved and will be implemented this year. (2) National Climate Inventory was completed ~6 months ago. This report has a lot of good information on weather and climate. (3) Handed out bound, hardcopies of the Network's Long-Term Monitoring Plan.
- In terms of climate change, he mentioned there has been an explosion of information over the last several years. Many more people are discussing climate change then in recent years. Many more people are supporting the concept of climate change then in the past. There is an overwhelming amount of information available and you have to be careful what you read. Kathy Jope and John

Morris have done a great job consolidating some of this information (websites listed on the [KLMN climate change workshop web page](#)).

- Wanted to make certain the focus of this workshop remained on the parks and not on the I&M Network. Trying to figure out what the parks know, suspect, or don't know about climate change and how we can create interpretive products to help the parks discuss climate change with the public.

### ***Presentations***

Several presentations were given related to climate change and the Pacific West Region. The presenters had a diversity of background and presentation topics. The presenter, titles of the presentation, key points, and a brief description are provided below. Full presentation can be obtained from the [Klamath Network internet web site](#).

#### ***KLMN Strategic Interpretive Plan presented by Steve Thede, WHIS***

Steve discussed the relationship between the Klamath Network and the interpretive staff at the 6 parks within the Network. In general:

- He provided an overview of the Strategic Interpretive Plan that was developed by the Interpretive, Network and Southern Oregon University staff.
- He discussed the 5 topics that will be addressed as part of the plan and provided rationale for moving climate change up in the rankings of priority.
- Steve also discussed the some general principles and key concepts related to interpretation and climate change including tangibles, focal elements and topics, current tools and policies, need for data, and the desire to tell a story to the public.

#### ***Overview of Climate and the NPS presented by Kathy Jope, PWR NPS***

Kathy provided a variety of information related to climate change in the Pacific West Region including:

- Definitions of Weather vs Climate
- Graphical and photograph representations of a variety of historic, current, and modeled parameters such as temperature, global climate forcings, precipitation, seasonal changes, glaciers, ice caves, and snow fall. The Western Regional Climate Change Center in Reno has many useful representations of the data for the area.
- She discussed some current expected changes in the PWR such as an increase in intense storms, more rain-on-snow events, shifting phenology and species ranges, groundwater availability, changes in sea gases and temperatures, expanding invasive populations and distributions, increase tree mortality and disease, increase fire, and patterns of potential change.
- She mentioned some specific changes that are occurring in our region include: The changes in our WINTER temperatures (northwest) are the most significant when compared with changes in other seasons (from NOAA). Lava Beds cave ice is decreasing (could be from warmer temps or less ground water). Stream flows are maxing out earlier in our region (more in March) and by June the flows are much lower than in the past. Snow lines are going up in elevation on mountains and in mid-elevations there is less albedo effect and those ecosystems are much warmer and drastically different than they used to be. Lassen and Shasta have greater snow depth and greater winter precipitation. Storm intensity measures show that storms are becoming LESS intense in our region (while being more intense in Washington State and S. California), another example of how climate change affects areas differently. Phenology of animals and plants (timing of migrations, habits, etc) are changing along with the ranges of animals and plants. Water temperatures appear to be changing (needs to be better studied). Thermoclines in lakes are moving to different

depths. Ocean currents are changing (noted effects on marbled murrelet and elephant seals). Expanding hypoxic zones along the west coast of U.S. (warmer waters = less Oxygen). Species with generalized habitat requirements are doing well (typically the invasive species) while those with specialized needs and have narrow ranges are dying out. Tree mortality is directly related to decreasing soil moisture. See Westerling et al (2006) for Northwest wildfire – climate relationship discussion.

- Kathy discussed the concept of positive feedback loops such as could occur with snowpack.
- She mentioned the impact that climate change would have on the NPS fire policies, if fire regimes change due to increasing temperatures, longer seasons, less available water, etc.
- She recommended several documents that discuss climate change ([see the KLMN Web page on climate change](#)).
- She explained how the NPS was trying to address climate change via studying the science, monitoring, mitigation, planning, stewardship, public involvement, and education. Kathy mentioned Leigh Welling is taking the lead on climate change for the park service. They are creating “[talking points](#)” for various bioregions. Mentioned it is important to separate what we actually know versus what we think we know. They are also learning about “scenario planning” to map potential changes associated with climate. This has been done at Joshua Tree NP.
- Kathy discussed several of the many mitigation methods the NPS is using including: changing energy sources (solar in over ½ of western parks), climate friendly park program, LEED, green purchasing, addressing climate change in NEPA.

***Adapting to Climate Change in the Pacific Northwest Forests presented by Dr. Jessica Halofsky, University of Washington***

Dr. Jessica Halofsky is a University of Washington postdoctoral research scientist who works with our Forest Service team on climate change issues. In her presentation:

- Jessica provided some “climate 101” information.
- Similar to Kathy, she provided several graphical representations of modeled changes to a variety of parameters such as temperature, CO<sub>2</sub>, sea level rise, wind patterns, precipitation, and the pacific decadal oscillation.
- Jessica discussed several potential biotic and abiotic response associated with climate change.
- She presented information on potential ways management could adapt to climate change. Adaptation strategies she discussed were (each has extensive detail on ppt slides):
  1. Increase landscape diversity
  2. Maintain biodiversity (modify genetic guidelines, assist colonization/migration, identify especially sensitive species)
  3. Plan to adapt to the changes that are inevitable; plan for post-disturbance management
  4. Implement early detection and rapid response
  5. Manage for realistic outcomes (identify key thresholds, prioritize where the limited resources will be allocated...)
  6. Incorporate climate change planning into restoration efforts (remember that historical references may not hold up anymore)
  7. Develop climate-smart government regulations
  8. Anticipate BIG surprises
- She mentioned humans are doubling CO<sub>2</sub> in the atmosphere in a “geological instant” and warming trends in the northwest are greater than the global average.

- She mentioned some key things for vegetation that might change including snowpack, growing season, soil moisture, thermal constraints, water constraints, disturbance regimes.
- She provided additional resources including:

UW Climate Impacts Group <http://www.cses.washington.edu/cig/>

US Climate change Science program <http://www.climatechange.gov/default.php>

IPCC 20pg synthesis for policy makers (SPM): <http://www.ipcc.ch/ipccreports/ar4-syr.htm>

***It Could Be Worse: Mass Extinctions and Global Warmings presented by John Roth, ORCA***

John provided good definitions on the various levels of extirpation / extinction. John reviewed some of the past extinction events and discussed the causes of those extinctions and how species reacted to those events. Some of the key concepts of his talk included:

- Discussed why the current rates of climate change could be more devastating than the previous causes that have led to an extinction event.
- Mentioned Paleozoic-Mesozoic extinction is the only one due to global cooling (snowball earth).
- Permian extinction is most similar to what is going on in present-day.
- Things got so severe in the Permian that all Bioremediation of CO<sub>2</sub> levels failed. Oxygen levels at sea-level were like those today on Mt. Everest. Since bioremediation failed, it took 15 million years for weathering of minerals and limestone to lower the CO<sub>2</sub> level – all the vegetation died which exposed more minerals to lower CO<sub>2</sub>.
- Cretaceous – dinosaur extinction (everything >2.5kg died) due to 2 meteors and volcanic eruptions. The only survivors were in the Appalachian and the Klamath mountains (diversity of habitats, places without trees so fires didn't spread and riparian refuges for tailed frogs, water lilies, and darlingtonia).
- Late Pleistocene large mammal extinction caused by human hunting & heat stress.
- The rate of change in the climate is key. If it's slow enough, things have time to adapt and evolve or move. Not enough time and you have extinction. Many of our KLMN endemic species are here because of the diverse habitats in our region and because the local changes happened at a rate that gave them time to adapt.
- Extinctions usually occur due to climate warming and some other factor. Ferns and fungus thrive at times of extinction since they have a lot to decay. Big animals and plants and those without wings are the most at risk. Narrow endemics (like we have) are also at great risk.
- At the Oregon Caves, cave warming has allowed ants to enter and eat the endemic species.
- Bioremediation is still in effect for our current climate situation – Permian was warmer and more severe.

***Climate Change at Oregon Caves National Monument During The Last 130,000 Years presented by Lica Ersek, Oregon State University***

Lica Ersek is a PhD student in the Department of Geosciences at Oregon State University. His current work involves high resolution paleoclimate reconstruction in western North America using stable Isotopes and trace elements in speleothems from Oregon Caves National Monument. Lica talked about:

- The variety of ways people have measured climate over the past years.

1. Ice Cores – air bubbles between ice crystals have extractable gasses; only found at poles and high elevations; can go back possibly 1 million years (Antarctica)
  2. Corals – Thousands of years; age with Uranium:Thorium ratio; VERY high resolution record (seasonal); only found in tropics
  3. Pollen – max of ~24,000 years of age
  4. Tree rings – only as far back as the age of the tree
  5. Speleothems (Stalagmites) – Annual record, OR caves has 300,000 year continuous record, date with Uranium:thorium ratio
- His talk concentrated on his method of reconstructing paleoclimate data using isotopes and trace elements in speleotherms.
  - He provided an overview on using isotopes to measure change.
  - He talked about the benefit of using caves as “climate archives”.
  - Lica showed some of the results from his current research. 130,000 year climate change record at ORCA. ~100,000 years ago was the last interglacial period and was a little warmer than our current climate and the sea-levels were ~6m higher. Could be a good analog for where we’re headed.
  - No stalagmite growth in ORCA for last 200 years, so no present-day conclusions.
  - Other cave studies are being done on east coast, China, and Europe.
  - OSU is working to develop a National library of stalagmite specimens to preserve for science.

***“Arranging for Change,” The Role of NPS in Communicating About Climate Change presented by John Morris, Alaska Region***

John discussed the reasons we need to use interpretive tools to communicate our knowledge about climate change to the public. He discussed some of the challenges that are associated with this task. John also discussed some of the tools that are available to help educate the public, including the “Decision Tree” presentation that he reviewed with the group. This presentation is available in [several locations](#) including the [KLMN web site](#). Some of his key points included:

- IPCC 4th assessment report (2007) states things like warming evidence is “unequivocal” and human causes are “very likely” (90%)
- Visitors to parks are asking about climate change. In 2004, Alaskan parks received complaints that climate change wasn’t being addressed well enough by interpreters.
- IPCC does good science but isn’t as skilled at communication. Who can and should communicate it? He argues that NPS interpretive staff is in a good position to do that.
- In a recent survey they found: 2/3 of adults say that climate change is a serious problem, 2/3 are also confident that individuals can do something to combat it, a greater percentage (3/4) of kids are aligned with this thinking.
- NPS message needs to convey hope as well. Motivate people to DO something.
- Arctic ice may be gone as soon as 5 years from now (new prediction); Sea ice is much thinner than it used to be when it forms on the oceans, so it melts farther faster.
- “It’s easier to talk about climate change on a global level because there’s more evidence for global changes and trends are more obvious than local ones”.
- See powerpoint slide on ‘strategies for communication’.
- Think about target audiences and develop different materials based on these:
  1. The uninterested/unaware
  2. The interested but not engaged
  3. The attentive and helpful

#### 4. The fully engaged

- Develop compelling stories with optimism.
- “Arrange for Change” Decision Tree is something he developed as a tool for interpretive staff. See: [nrpcsharepoint/climatechange](http://nrpcsharepoint/climatechange). Branches of tree are issues/consequences of climate change – multiple branches combine to larger issues.
- Suggested using idea on questions to present material: “what is happening to glaciers?” connect it to the melting ice all over the world due to global warming and turn it into an invitation to stewardship.
- The goal in an answer is to get to “Why does it matter” and “What can you do”.

#### ***Discussion on Broad Scale Topics***

The original plan for Tuesday afternoon was to come up with a variety of broad topics that would help us focus our discussion on Wednesday. Initially, the discussion went a variety of different paths because it was such a broad scale discussion. In the end a list of broad topics was determined, which helped provide ideas and structure for the discussions on Wednesday morning. In addition, several key points, comments, and concerns were discussed, which included:

- 1) Many of the park staff noted that there is very little data that can be contributed by the parks to address climate change, however there are some data such as opening day of the road in LAVO and cave ice data in LABE. In addition, there is peer-reviewed information from the PWR that could be used to discuss POTENTIAL effects to the parks in this network.
- 2) It will be important to answer the “Why should we care” type questions when we talk to the public. Some suggestions were to look at examples of how climate change will affect natural resources that have an influence on the human population. Some examples were northern California agriculture crops which may be affected due to timing and how it relates to phenology. Early budding and leafing of plant at peoples homes was another example.
- 3) Another important point was the need to have the people in this area relate to what we are talking about. Glaciers don’t really have an affect here that people visiting our parks can relate too. One suggestions was to relate the number of frost free days. LABE has good pictures of changes in cave ice.
- 4) When discussing phenology, several examples were given on how the “biological clock” of species may be affected if patterns of climate change persist. Examples such as the swallow-mosquito relationship and the bee-flower relations where discussed. In many cases the biological clock is dependent on temperature or day length.
- 5) There was a discussion / concern of the need for quality facts versus anecdotal information. The need was stated for long term monitoring information (such as what is being collect by the I&M program). See #1 above about the lack of information at the park level. Suggested that there is science and peer review literature that discusses climate change and natural resources but it is not for our area. However this information could be used to help educate the public about what COULD happen here because we have similar species / habitats. The key is to be careful on how we word things but this will be the interpreter’s job. Do not want to make it seem like climate change is the cause of everything.
- 6) There was a good discussion on making certain we understand the audience when we develop the end product. There are lots of ways to get the public involved in the work we do but we need to

make sure we can educate the public so they better understand how climate change could affect the park resources. The point was brought up that while we usually try to stay positive, we also don't want to "sugar coat" the potential effects of climate change. When thinking about the audience, the 5 stages of grief were mentioned (denial, anger, grasping for straws, overwhelmed, and acceptance). We need to remember the people from are audience could be in any of these categories.

- 7) It was made clear that while we are interested in coming up with a list of topics to help the interpretive staff discuss how climate change may affect the parks resources, for this project we want to try and find one or two projects that is pertinent to all the parks. It is recognized that this is a difficult task since the parks are very different. However, it is doable and a few suggestions were recommended (see list of topics below). People come to each park for different reasons; we can have themes that tie all parks together through climate change in this project and parks can develop more site-specific (e.g., loss of redwoods, lake clarity, water levels, etc.) information on their own.
- 8) There was some discussion in the I&M role in monitoring climate change. While the I&M program (at the Network and WASO) scale will be collecting data that could be analyzed to see if climate change is a potential factor that is affecting a vital sign, the I&M program is just one small part of the NPS. We can not rely on just the I&M program to provide all the data and answers. It will need to be a cooperative effort (both within and outside the NPS).
- 9) It was brought up that we do not want to forget the relationship between cultural resources and climate change. While we did not want to downplay the importance of cultural resources it was felt this 2-day meeting was not long enough to get into the details of both cultural and natural resources. However, it is recognized that there are strong relations between cultural resources, natural resources, and climate change.
- 10) Several broad issues were listed in which the group could examine these broad issues, find out what concerns each park has related to climate change and these broad issues, and then an interpretive project could be developed from this information. The broad topics were:
  - Wildland Fire
  - Changing Precipitation Regimes (Snow Depth, Increased Flooding, drought, etc)
  - Recreation
  - Biology (Changing species distribution, range extensions and contractions, Phenology, Pollen, Genetic Diversity)
  - Hydrology (flooding, increased early spring rains, decrease / increase of snow, drought, snow pack)
  - Marine Systems
  - Non-Native Species
  - Changes in Cultural Resources

**May 7<sup>th</sup> (Wednesday)**

### ***Discussion on Park Specific Topics***

After discussions about broad topics related to climate change, the group broke out into small groups organized by park to come up with 5 (or more) natural resource oriented topics that are currently or could become an issue related to climate change. Each park had 2 hours to come up with their list and then presented the list to the group. The goal is to look at what topics are important to each park and then determine which topics may expand across the network.

### Lava Beds:

1. Cave ice decline (age of ice unknown)
  - LABE has 32 ice caves, 11 monitored for 15 yrs, even others have obs, interp, etc. In 1989, noted first loss of ice, now loss in 80% of caves, total loss in 10 caves, microclimate threshold can push ice through that phase change.
    - a. Why don't we have replacement of seasonal ice?
    - b. No atmospheric sampling of the ice in the caves, are we melting ice that's 10, 50, 5000 yrs old?
    - c. Find correlation of temp, precip, etc. total effects on the ice.
      - a. LABE has temp records starting in 1946. Preliminary looks at the data indicate that there has been about a 1.5 degree F increase in the mean highs, while maintaining stable lows.
      - b. It would be easy to involve other weather stations for further collaboration in a regional look at what's going on.
2. Bats (hibernation timing, pup birth timing)
  - Townsends big ear bats - hibernation, maternity colonies, hibernacula, pups - timing is very important and tied to temp. Colonies regulate time of birth to temperature.
3. Ecotone shifts
  - Ponderosa Pine is moving up, juniper moving into the park, sage and juniper shifting.
4. Bird migration timing
  - Local migration of scrub jays into the park
  - Say's Phoebe migration timing
5. Pika in basalt-fields (limited range)
  - Tied to environment, possible local extirpation

Other: work with USFS to monitor nearby lake changes (e.g., thermoclines in Medicine Lake).

Have data for several of the groups listed above but have not done much analysis in the scope of climate change.

### Lassen Volcanic:

1. Snow-pack and precipitation patterns
  - Precipitation, snowpack, and watershed.
  - Lots of data since 1920s including PG&E samples, road opening data.
  - This could lead into a number of stories that we can relate to visitors and recreation such as when people access the park and avalanche dangers.
  - Could get some more visitor observations, field notes, data, quite a number of folks collect this information.
  - Looking at getting lake data and pH of precipitation, what type of story this makes.
2. Wildland fire (pattern, seasonality, management changes)
  - Wildland fire affects recreation, health, visual smoke, and park accessibility.
  - Changes in pattern of fire, seasonality, change in management.
  - Vegetation changes from fire (e.g., invasives, opportunistics, sensitive spp)
  - Effects on wildlife and management aspects surrounding this
  - Safety, wildland urban interface, management procedures
3. Species and habitat management (aspen, bird migrations, pika, butterfly migrations, bear ecology, cascade frog reintroduction)
  - Don't have a real accumulation of data yet, but can say here are questions we are asking. Several studies that could be used include:
    1. Aspen here and in Lassen National Forest



2. Bird mist netting data, timetables, when/which birds moving through, real opportunity to see patterns, when changes.
3. Pika study
4. Connect flowers and critters to people, indicators.
5. Butterflies and when they come.
6. Bear ecology of the park.
7. Lake biology and reintroduction of cascades frog.
4. Park sustainability
  - Climate-friendly park program. Visitor center has lots of features, showing leadership as park, agency, helping to deal with climate change.
5. Air-Quality (Volcano-climate change relationship)
  - Interesting story: the effects of volcanoes on air quality and climate change; what if Lassen erupts again? Fits in with primary interp theme of geology.

Crater Lake: (Should be noted natural resource staff for CRLA had to leave the meeting early so the CRLA interpretive staff came up with these topics based on discussions with the park staff.)

1. Pinebark beetle, Whitebark pine, Clark's nutcracker, and blister rust all fit together. Last year was a low snow year. Beetles showed up a month earlier than usual, trees were more vulnerable. Important to show visitors, up at rim it is easy to show visitors. Are the pine bark beetles at higher elevations? Maybe at the rim more in recent yrs? Look into further. Whitebark pine significant relationship with Clark's nutcracker, maybe weaken trees, make more susceptible to beetles etc.
2. Lake factors (any change is significant). The lake is very unique and it is important to keep each parameter (temperature, geology, organisms, water quality) of the lake in balance, a shift in these parameters could change the unique properties (color, thermocline, etc) of the lake. Would be good to get more info on the studies the park has been doing.
3. Snowpack and precipitation patterns. Snowpack, precipitation, water content, and melting are important. The park is always measuring and can share the data. Snowpack important to surrounding communities. Significant water issues in Klamath basin when the water isn't at normal level, three rivers flow out of park, important there too. Water is a universal concept and we can relate to it to all parks in the network.
4. Pika. Don't know too much about them, but we will be getting more info about them from an upcoming inventory.
5. Impacts of climate change on traditional uses (huckleberry ethnobotanical data). CRLA is sacred to Klamath tribe and others. Huckleberries are historically important and tribes still come up to area to gather the berries. Ethnobotanical data - are the plants being impacted, impacting traditional use? Something worth exploring.

Other: recreation in and outside of park (fishing/boating), wildland fire

#### Redwood:

In terms of climate change, Redwood staff pointed out they are unique when compared to the other parks in the network because they live in a climate moderated coastal environment with large human impacts. As an example they compared themselves to a body that is in distress. While areas around them will probably see the greater influences of climate change, REDW will probably be the last in their region to feel the affects of climate change. Areas important to them included:

1. Coastal zone changes:
  - a. Common Murre is a key bird in this region. Also gave an example of the 2005 change in the pattern of the sea. No upwelling event which limited the number of available

fish so birds could not eat. In addition, they thought ocean bird migration should be monitored but they currently have little data.

- b. Tide-pools, sea level rise, temperature, blackrock fish rearing, whale populations (gray whale) are all important and could be affected by changing climate parameters.
- c. Wind and Ocean pattern changes affecting food sources for birds and other species.
2. Inland:
  - a. Native insect populations. Currently do not have information. Concerns with competition from non-native species. Example of the Crescent Butterfly that is near extinction. It is already stressed because of a limited distribution and might not fair well with increase in competition.
  - b. White Oak woodlands. This is a health population and a key food source. Feel it is important to monitor so we can tract the change in this species over time.
  3. Native American histories. Natives have document several patterns of species distribution that they have relied on in the past. However with changing climates, these species patterns are shifting and no longer follow the timing that was historically documented.

Other: changes in fog (unknown), deforestation, human-disturbances and climate change synergy

#### Oregon Caves:

1. Bird migrations and population changes. Currently have a mist netting project in place with the Klamath Bird Observatory and the I&M Program.
2. Phenologies: Harvestmen (daddy long-legs), moth species, bats (new species, range changes). Some research from the 1950's
3. Nitrogen content of cave and surface water, pH, and total dissolved organics. Need to monitor for baseline information that we do not already have. This data could be used to measure the productivity of the forest.
4. Reducing park carbon emissions. Need to research the various methods associated with reducing carbon emissions and try to find out which methods the park could feasibly incorporate into their parks.

Other: Stalagmite paleo studies

#### Whiskeytown:

Water:

1. Water and Watershed. Water use competition (power, agriculture, recreation, fish habitat). This could be a good opportunity to illustrate how the public is directly affected by changes in the availability of water. Could look at factors such as snowpack, extreme precipitation events, effects on aquatic community, clean water availability, etc. Also could illustrate the effect of water (and cold water) on salmon habitat.

Fire:

2. Changing frequency and severity. Lots of activity has occurred at WHIS and we could look at the resilience of the forest because this is very important so we don't have extreme fire events. Talked about the ability to discuss fire, prescribe burning, WUI, and how this connects to the public. They discussed the possibility of explaining landscape planning around their (public) homes, shade and drought tolerant plants, etc. Discussed short term versus long term emissions from prescribe fire versus forest health.
3. Discussed the PWR goal of becoming carbon neutral by 2016. They talked about needing to work with the public and partnerships to meet these goals. They also discussed the need to research some of these ideas.

4. Discussed the important of NPS sites in the future. Wondered if these parks will become important as a refugia for wildlife or places more people will come to recreate. Will current “low use zones” become higher in some of the parks as more people come to the parks to escape the extreme temperatures?

### ***Afternoon Discussion On Interpretive Products***

During the afternoon session, the objective of the discussion was to just have a short brainstorming session to try and come up with a few ideas for interpretive products to be developed. While no final products were decided, this discussion will enable the Network and Interpretive Chiefs to work with a McNair Scholar (or 2) to help develop some ideas and eventually a good product. Some of the key points that came out of this discussion included:

- Sean Mohren provided an overview of the McNair Scholar program. It is the goal of the Network to have one or two McNair scholars work with the Network and the Chiefs of Interpretation to develop some useful materials that the park staff can use to discuss climate change at their parks.
- Need to make sure we understand the audience the product will be created for. Also need to make sure we are telling a story and recognize climate change may be only part of that story. We also want to make sure the end product motivates people to action. Need to make certain we connect with the audience. The topics all need to be ones that people can relate to; people can take home the message from the parks and relate it to their life.
  - i. We should make sure that even though the scale of the climate change issue is so big, we can connect the public to meaningful, specific examples (e.g., spring getting earlier by 8 hrs/year or ORCA’s limestone cave developing by the thickness of a paper sheet/year.)
  - ii. We should work on defining the target audience, whether internal park staff or beyond.
- Several broad topics that each park (or many of the parks) have in common were discussed as potential projects including:
  1. Precipitation
    - a. Water in general
  2. CO<sub>2</sub> and Greenhouse Gases
  3. Fire
  4. Visitor Use / Recreation
  5. Ecotone Shifts
  6. Park Sustainability
- It’s good for the parks to have a large, broad list like this. Then the interpretive staff can refine the ideas and suggestions to ones that will specifically work to communicate climate change on the park-level/network-level and a McNair Scholar could pick from among those topics for a project.
  - a. We will meet with the McNair staff and Scholars and then have another meeting with the Interp Chiefs about what exactly the next steps will be, who to bring on, when, and for what project.

### ***General Climate Change Research Ideas***

With the little amount of time left before the meeting ended, the group tried to come up with some additional research ideas (related to climate change) that could be examined for their usefulness in the future. Some suggestions included:

- Cave ice aging (LABE)
- Pack-rat midden paleoclimate reconstruction (LABE)
- Data analysis for snowpack and road opening dates (LAVO)
- Glacier history (LAVO)

- Analysis of data on migratory species (first arrivals, breeding bird surveys, bats) (Regional)
- Look at other research on butterfly, bird, and bat migrations.
- Analysis of oral history, pictures to expand on historical knowledge of parks (extrapolate potential changes).
- Regression analyses/correlations between various factors.
- Keystone species monitoring: Whitebark Pine, amphibians, Pika, any species on edge of their range.
- Baselines of productivity in water bodies, dissolved oxygen, dissolved and total organic carbon.
- Management in parks and what are the results (results from fire management changes, dam removal, reducing energy consumption) – what should we be doing to react to climate change?
- Insect changes.